Laser Scanner Protection for Automated Conveyor Car Using MSR200 Series Modular Safety Relay

Non-networked (Hard-wired) Example
Safety Rating: Category 3 according to EN954-1

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Introduction

This application example describes a safety system applied to the movement of an automated conveyor car. Laser scanners are placed in the front and back of the car. The scanners detect objects in the car's path and issues a stop command to the drive motors if an object is detected. The scanners are connected to an MSR200 safety relay, which monitors both scanners and the E-Stop push button.

Features and Benefits

- A single MSR200 relay controls both the E-Stop and two laser scanners.
- No safety control programming is required.
- This type of solution is applicable to many industries (for example, material handling, packaging, and automotive).

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
SHOCK HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

General Safety Information

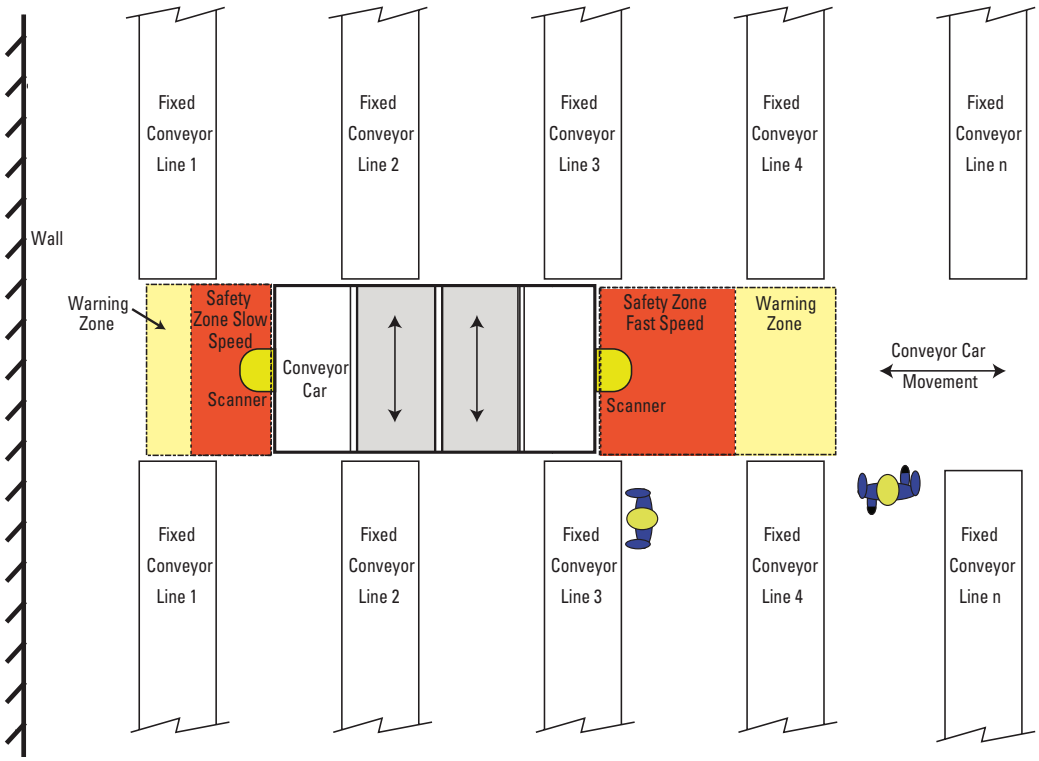
IMPORTANT This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.

ATTENTION

A risk assessment should be performed to make sure all task and hazard combinations have been identified and addressed. The risk assessment may require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations which are not part of the scope of this document.

Contact Rockwell Automation to find out more about our safety risk assessment services.

Description



The automated conveyor car moves forward and back within a designated aisle. The conveyor transports materials from one fixed conveyor line to another.

The conveyor car moves at two speeds: fast and slow. The safety zone of the scanner must be adjusted for a longer range when moving fast and can be adjusted for a shorter range when moving at slow speed.

Safety Function

When an object is detected in the safety zone, the conveyor car must stop moving or must remain stopped if not moving. When the safety zones are clear, the car can move.

Stopping Time and Safety Distance

Calculate the necessary safety field length using the formula:
Safety Field Length = SA + ZG + ZR + ZF + ZB.

where:

- SA = Stopping distance
- ZG = General safety supplement = 100 mm (3.94 in.)
- ZR = Supplement for any measurement error of the SafeZone Multizone safety laser scanner related to reflection
- ZF = Supplement for any lack of ground clearance of the vehicle
- ZB = Supplement for the reduction in the braking performance of the vehicle as defined in the related vehicle documentation

Refer to the SafeZone Multizone Safety Laser Scanner User Manual, publication 75046-171-01(A), for details on the safety distance length for mobile applications.

Example Bill of Materials

This safety application example uses these components.

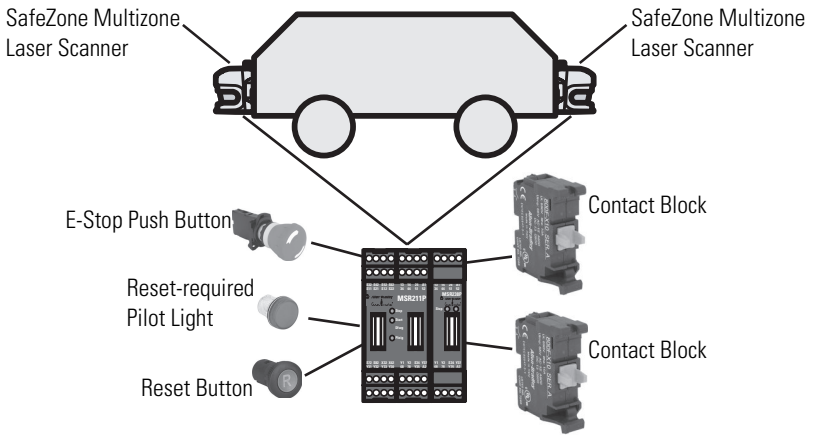
Cat. No.	Description	Qty
440L-SFZNMZ	SafeZone multizone laser sensor	2
442L-CSFZNMZ-20(1)	Pre-wired Cable with memory module 20 m (65.6 ft) cable	2
440R-H23177	MSR211 modular safety relay	1
440R-H23196	MSR238 output module with delayed outputs	1
800FM-MT44	E-Stop push button, twist-to-release, trigger action	1
800F-X01S	Self-monitoring contact block	1
800F-X01V	1 N.C. contact, low current QuadCONNECT	1
800F-15YE112	Yellow legend, 60 mm (2.36 in.), emergency stop	1
800FM-R611	Reset button, blue, flush operator, “R” legend, metal body	1
800F-MX10V	Metal latch, 1 N.O. contact, low voltage QuadCONNECT	1
800FM-P6	Reset-required pilot light, blue, round metal operator	1
800F-MN3B	Metal latch, LED, screw clamp, 24V dc, blue	1

(1) 442L-CSFZNMZ-10 is a 10 m (32.8 ft) cable.

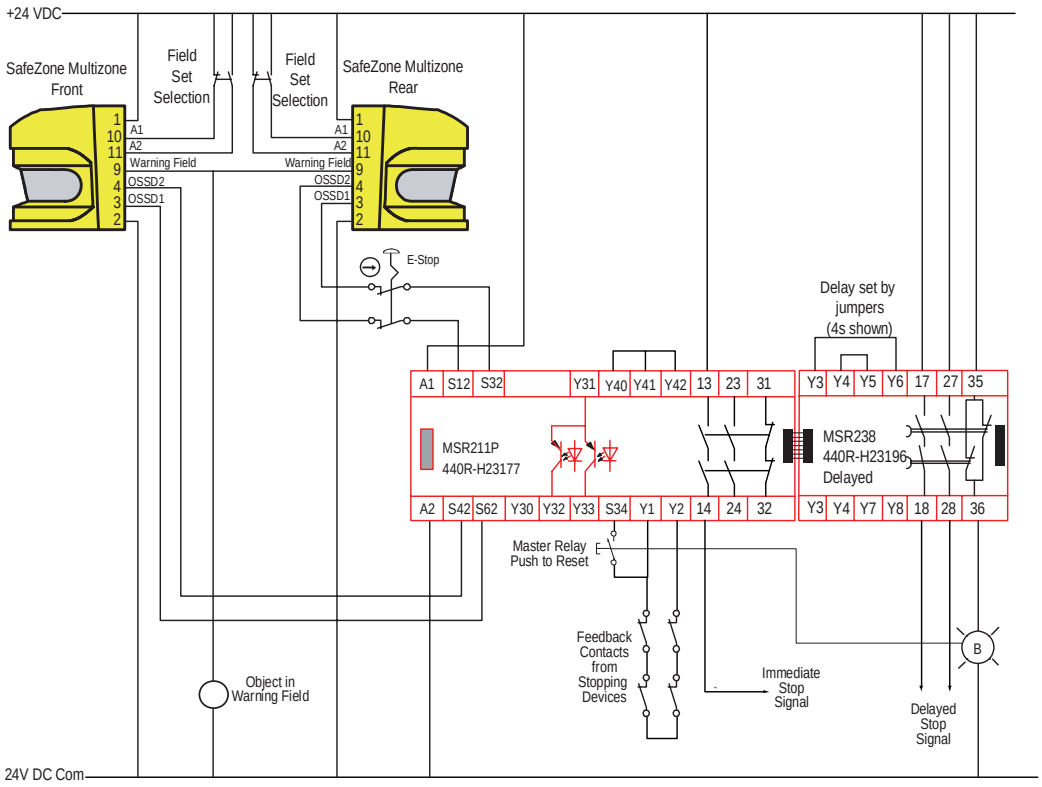
Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the Additional Resources section on page 12.

System Overview



Wiring



Each scanner can have two separate, selectable field sets, with each set consisting of a warning field and a safety field. The field sets are selected by inputs A1 and A2. The A1 and A2 inputs use a combination of one normally closed and one normally open contact to help reduce the probability of a fault due to shorting.

Both scanners are active all the time. To prevent nuisance stops, the field of the scanner not in use should be set to the slow field.

An object in the warning field of either scanner will energize a signal. This allows personnel to back away from the car before a safety stop is initiated.

The MSR211 relay continuously monitors both scanners and the E-Stop push button. The safety zone of each scanner must be clear and the E-Stop must be reset for the MSR211 relay to be ready for reset. Pressing the reset activates (closes) the safety outputs of the MSR211 and MSR238 relays.

Obstructing either scanner's safety zone or pressing the E-Stop will initiate a stop. The safety outputs of the MSR211 relay will open to remove power to the motor drivers. The safety outputs of the MSR238 relay will open after the configured time delay expires. The time delay is set by jumpers.

Refer to the Rockwell Automation Safety Products Catalog or MSR211 instruction sheet, listed in the Additional Resources section on page 12, for other timing options (0.5… 300 s).

Configure the Laser Scanner

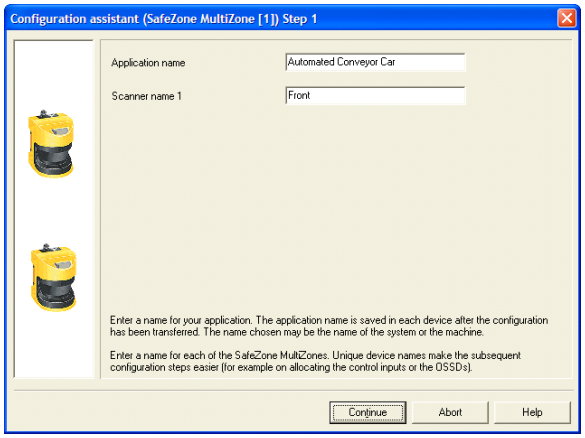
The software dialogs on the following pages illustrate the steps and configuration settings needed to configure this application example using the Configuration Assistant in the Safety Configuration and Diagnostic (SCD) software.

TIP The SafeZone Multizone software cannot run while RSLinx software is running. In your icon tray, right-click the RSLinx icon and choose Shutdown RSLinx. RSLinx software automatically loads again when you run RSNetworx for DeviceNet software.

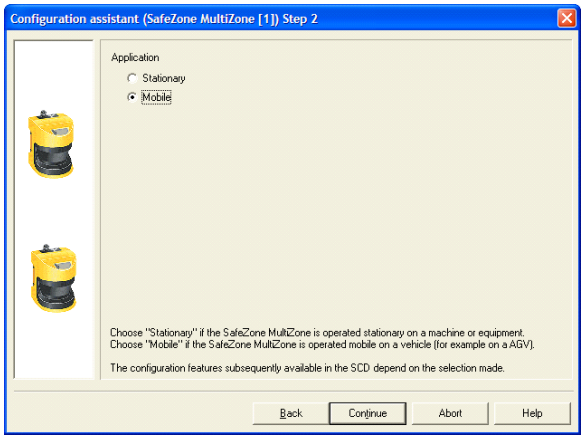
The default password for the laser scanner is ABGM. For demonstration purposes, log in as an Authorized Client.

1. Enter a name for your application.

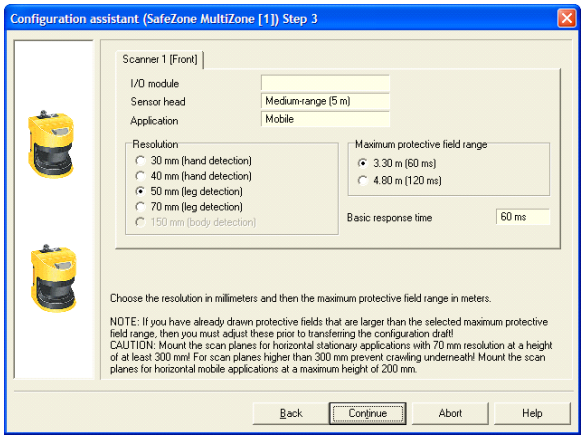
2. Enter a unique name for the SafeZone MultiZone scanner.


Configuration assistant (SafeZone MultiZone [1]) Step 1
Application name
Automated Conveyor Car
Scanner name 1
Front
Enter a name for your application. The application name is saved in each device after the configuration has been transferred. The name chosen may be the name of the system or the machine.
Enter a name for each of the SafeZone MultiZones. Unique device names make the subsequent configuration steps easier (for example on allocating the control inputs or the OSSDs).
Continue
Abort
Help

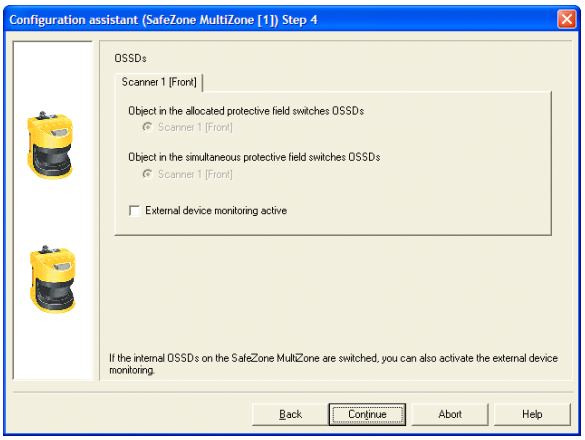
3. Choose the type of application to indicate whether the SafeZone MultiZone scanner is operated on a stationary machine or mobile vehicle.


Configuration assistant (SafeZone MultiZone [1]) Step 2
Application
Stationary
Mobile
Choose "Stationary" if the SafeZone MultiZone is operated stationary on a machine or equipment.
Choose "Mobile" if the SafeZone MultiZone is operated mobile on a vehicle (for example on a AGV).
The configuration features subsequently available in the SCD depend on the selection made.
Back
Continue
Abort
Help

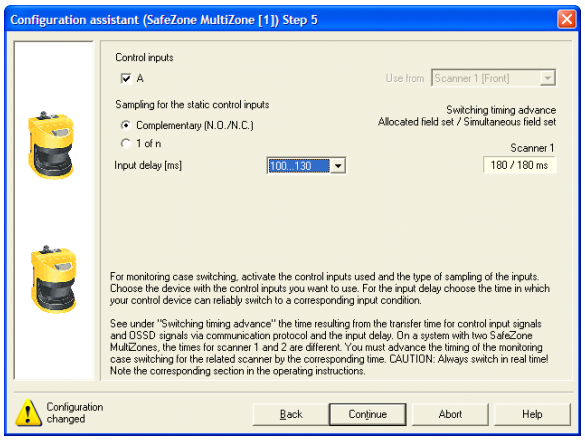
4. Configure the scanner.


Configuration assistant (SafeZone MultiZone [1]) Step 3
Scanner 1 [Front]
I/O module
Sensor head
Medium-range (5 m)
Application
Mobile
Resolution
30 mm (hand detection)
40 mm (hand detection)
50 mm (leg detection)
70 mm (leg detection)
150 mm (body detection)
Maximum protective field range
3.30 m (60 ms)
4.80 m (120 ms)
Basic response time
60 ms
Choose the resolution in millimeters and then the maximum protective field range in meters.
NOTE: If you have already drawn protective fields that are larger than the selected maximum protective field range, then you must adjust these prior to transferring the configuration draft!
CAUTION: Mount the scan planes for horizontal stationary applications with 70 mm resolution at a height of at least 300 mm! For scan planes higher than 300 mm prevent crawling underneath! Mount the scan planes for horizontal mobile applications at a maximum height of 200 mm.
Back
Continue
Abort
Help

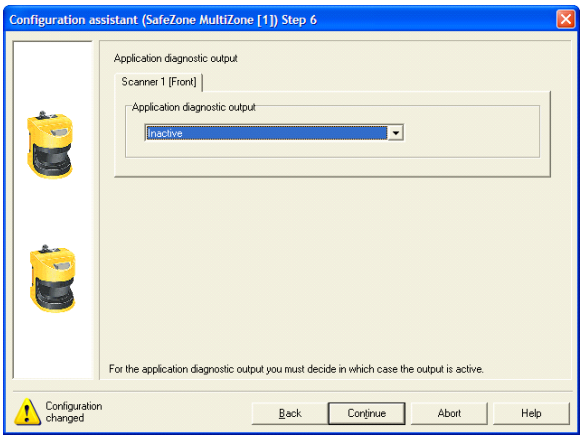
5. Choose the OSSD configuration for the scanner.


Configuration assistant (SafeZone MultiZone [1]) Step 4
OSSDs
Scanner 1 [Front]
Object in the allocated protective field switches OSSDs
Scanner 1 [Front]
Object in the simultaneous protective field switches OSSDs
Scanner 1 [Front]
External device monitoring active
If the internal OSSDs on the SafeZone MultiZone are switched, you can also activate the external device monitoring.
Back
Continue
Abort
Help

6. Configure the scanner's inputs.

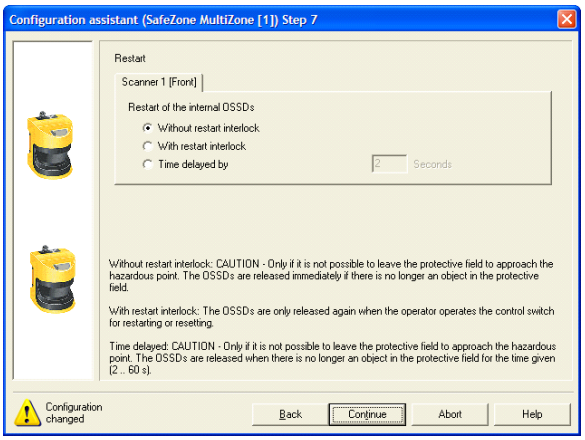

Configuration assistant (SafeZone MultiZone [1]) Step 5
Control inputs
A
Use from
Scanner 1 [Front]
Sampling for the static control inputs
Complementary (N.O./N.C.)
1 of n
Input delay [ms]
100...130
Switching timing advance
Allocated field set / Simultaneous field set
Scanner 1
180 / 180 ms
For monitoring case switching, activate the control inputs used and the type of sampling of the inputs. Choose the device with the control inputs you want to use. For the input delay choose the time in which your control device can reliably switch to a corresponding input condition.
See under "Switching timing advance" the time resulting from the transfer time for control input signals and OSSD signals via communication protocol and the input delay. On a system with two SafeZone MultiZones, the times for scanner 1 and 2 are different. You must advance the timing of the monitoring case switching for the related scanner by the corresponding time. CAUTION: Always switch in real time! Note the corresponding section in the operating instructions.
Configuration changed
Back
Continue
Abort
Help

7. Configure the scanner's output.

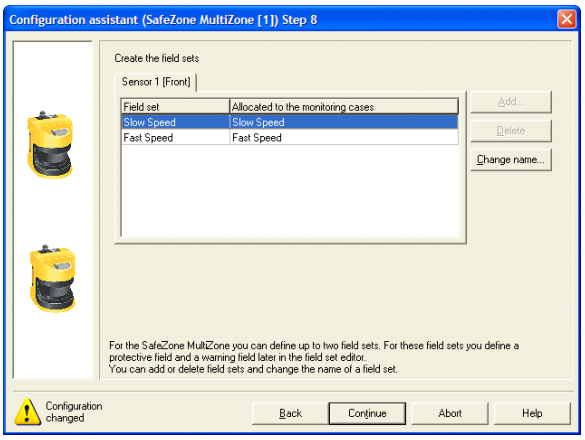


8. Choose the type of restart for the scanner.

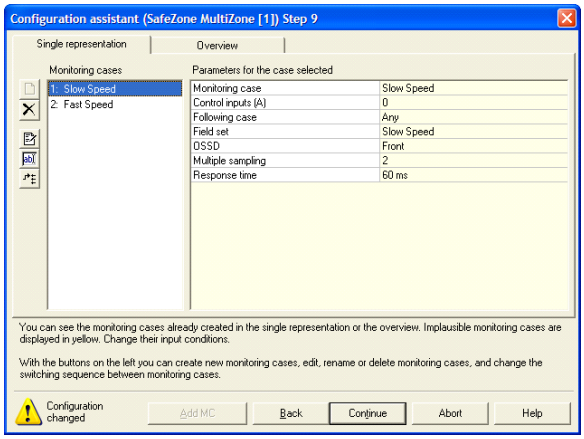
The Configuration Assistant dialog provides information about each type of restart.

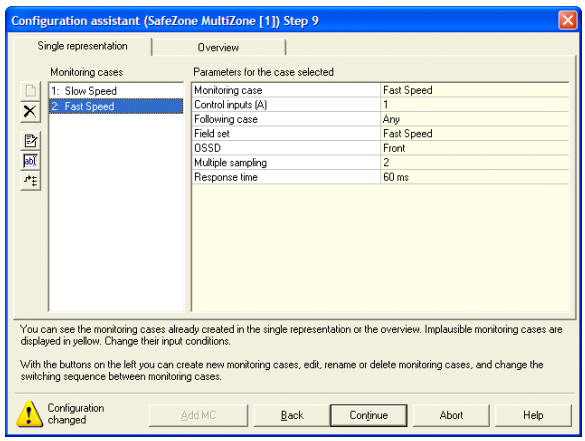

Configuration assistant (SafeZone MultiZone [1]) Step 7
Restart
Scanner 1 [Front]
Restart of the internal OSSDs
Without restart interlock
With restart interlock
Time delayed by
2
Seconds
Without restart interlock: CAUTION - Only if it is not possible to leave the protective field to approach the hazardous point. The OSSDs are released immediately if there is no longer an object in the protective field.
With restart interlock: The OSSDs are only released again when the operator operates the control switch for restarting or resetting.
Time delayed: CAUTION - Only if it is not possible to leave the protective field to approach the hazardous point. The OSSDs are released when there is no longer an object in the protective field for the time given (2 .. 60 s).
Configuration changed
Back
Continue
Abort
Help

9. Create two field sets for the scanner.

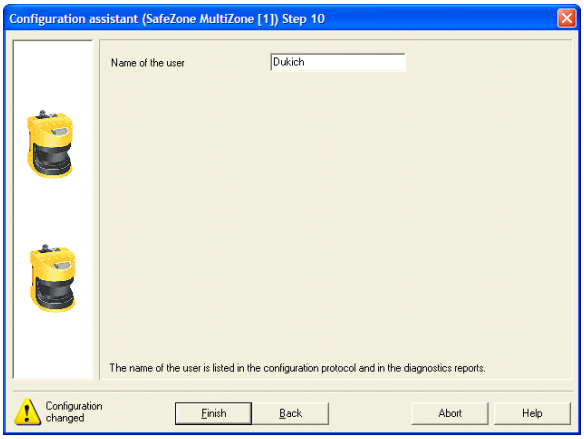

Configuration assistant (SafeZone MultiZone [1]) Step 8
Create the field sets
Sensor 1 [Front]
Field set
Allocated to the monitoring cases
Slow Speed
Slow Speed
Fast Speed
Fast Speed
Add...
Delete
Change name...
For the SafeZone MultiZone you can define up to two field sets. For these field sets you define a protective field and a warning field later in the field set editor.
You can add or delete field sets and change the name of a field set.
Configuration changed
Back
Continue
Abort
Help

10. Review and finalize the configuration for each field set you created.





11. Enter the user name you want to appear in the configuration protocol and diagnostic reports.

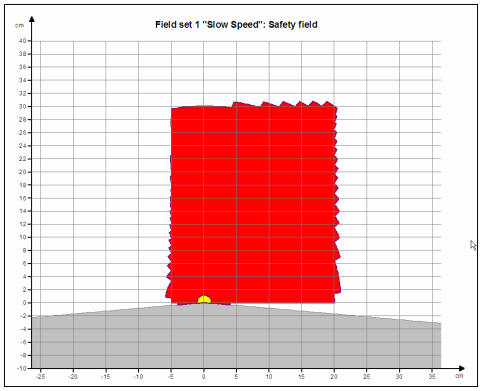


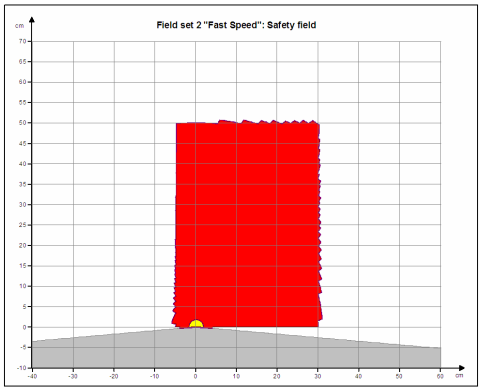
12. Repeat these configuration steps for the second scanner.

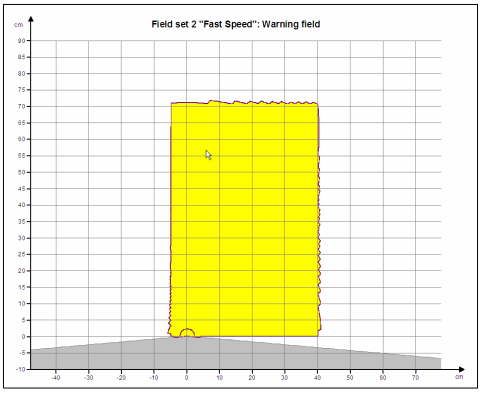
TIP Press the PgDn key to let the program download. The "Acknowledge" becomes live.

Performance Data

These field sets for the laser scanner are provided as examples. The actual field sets depend on the conveyor aisle and the conveyor speed. For demonstration purposes, the fields are asymmetric and short.







Additional Resources

For more information about the products used in this example, refer to these resources.

Resource	Description
SafeZone Multizone Safety Laser Scanner User Manual, publication 75046-171-01(A).	Provides information on installing, wiring, configuration, commissioning, and troubleshooting a SafeZone scanner.
Safety Relay - Minotaur MSR211P Installation Instructions, publication 57518/1.	Provides information on operation, installation, wiring, and technical specifications for the MSR211P safety relay.
Rockwell Automation Safety Products Catalog, publication S115.	Provides information on Rockwell Automations safety product offerings.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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